

CLAIMS:

1. A bonding apparatus which performs bonding with a focal point position varied for an object of bonding that has a plurality of different heights, said bonding being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a parallel flat plate, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding apparatus is characterized in that

said light path that passes through a parallel flat plate is a light path which:

receives light rays from said object of bonding,

conducts light rays from said object of bonding to said two-dimensional image sensor after causing said light rays from said object of bonding to pass twice through a parallel flat plate that has a refractive index and thickness that corresponds to a height of said object of bonding, and

varies a focal point position of an optical system while eliminating by mutual cancellation an image deviation generated by a passage of said light rays through said parallel flat plate.

2. The bonding apparatus according to Claim 1 characterized in that,

a mirror-reflection-operation optical element, which performs a mirror reflection operation, in a plane perpendicular to an optical axis, on light rays that are incident from one surface of said parallel flat plate and pass through said parallel flat plate, thus causing said light rays to be incident on another surface of said parallel flat plate, is provided in said light path that passes through said parallel flat plate,

so that light rays, which are incident from said other surface of said parallel flat plate and again passes through said parallel flat plate, are conducted to said two-dimensional image sensor.

3. The bonding apparatus according to Claim 1, characterized in that a rotational-operation optical element which makes a 180-degree rotational operation about an optical axis

on light rays that are incident from one surface of said parallel flat plate and pass through said parallel flat plate, thus causing said light rays to be incident again on said first surface of the parallel flat plate, is provided in said light path that passes through said parallel flat plate, so that

light rays, which again pass through said parallel flat plate, are conducted to said two-dimensional image sensor.

4. The bonding apparatus according to Claim 1, characterized in that said light path that passes through said parallel flat plate is provided at an intermediate point on a light path that extends from said object of bonding toward said image focusing lens, in a case where an optical system of said optical measuring instrument is an object-side telecentric optical system.

5. The bonding apparatus according to Claim 1, characterized in that said apparatus includes:

a parallel flat plate set in which a plurality of parallel flat plates in which an amount of light path length variation is respectively different are provided as a single set, and

a parallel flat plate selection and disposition means which selects at least one parallel flat plate from said parallel flat plate set and disposes selected flat plate in said light path that passes through parallel flat plates.

6. The bonding apparatus according to Claim 5, characterized in that ratio of said amount of light path length variation between the respective parallel flat plates in said parallel flat plate set is set to be 2.

7. A bonding apparatus which performs bonding with a focal point position varied for an object of bonding that has a plurality of different heights, said bonding being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a light path length varying element, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding apparatus is characterized in that:

said light path that passes through a light path length varying element includes a parallel reflective mirror as a light path length varying element, said parallel reflective mirror being comprised of two reflective surfaces facing each other and disposed parallel to each other at a specified interval and varying a light path length of light rays that pass through said parallel reflective mirror when said parallel reflective mirror is rotated as a whole about a rotational axis that is perpendicular to an optical axis; and

said light path that passes through a light path length varying element is a light path which:

receives light rays from the object of bonding,

conducts the light rays from the object of bonding to said two-dimensional image sensor after causing said light rays from the object of bonding to pass twice through said parallel reflective mirror that varies the light path length according to a height of the object of bonding, and

varies a focal point position of an optical system while eliminating, by mutual cancellation, an image deviation generated by a passing of said light rays through said parallel reflective mirror.

8. A bonding apparatus which performs bonding with a focal point position varied for an object of bonding that has a plurality of different heights, said bonding being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a light path length varying element, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding apparatus is characterized in that:

said light path that passes through a light path length varying element includes a four-reflection-surface reflective mirror as a light path length varying element, said four-reflection-surface reflective mirror being comprised of four reflective surfaces facing each other and disposed parallel to each other at a specified interval and varying a light path length that corresponds to a light path length inside said four-reflection-surface reflective mirror,

relative to a case in which said four-reflection-surface reflective mirror is not inserted, when said four-reflection-surface reflective mirror is inserted as a whole in a light path; and

said light path that passes through a light path length varying element is a light path which:

receives light rays from the object of bonding,

conducts the light rays from the object of bonding to said two-dimensional image sensor after causing said light rays from the object of bonding to pass twice through said four-reflection-surface reflective mirror that has a light path length corresponding to a height of the object of bonding, and

varies a focal point position of an optical system while eliminating, by mutual cancellation, an image deviation generated by a passing of said light rays through said four-reflection-surface reflective mirror.

9. The bonding apparatus according to Claim 7 or 8, characterized in that:

a mirror-reflection-operation optical element, which performs a mirror reflection operation in a plane perpendicular to optical axis on said light rays that are incident from one side of said light path length varying element and pass through said light path length varying element, thus causing said light rays to be incident on another side of said light path length varying element, is disposed in said light path that passes through a light path length varying element;

so that said light rays, which are incident from said another side of said light path length varying element and again pass through said light path length varying element, are conducted to said two-dimensional image sensor.

10. The bonding apparatus according to Claim 7 or 8, characterized in that:

a rotational-operation optical element, which makes a 180-degree rotational operation about optical axis on said light rays that are incident from one side of said light path length varying element and pass through said light path length varying element, thus causing said light rays to be incident again on said one side of said light path length varying element, is disposed in the light path that passes through a light path length varying element;

so that said light rays that again pass through said light path length varying element are conducted to said two-dimensional image sensor.

11. The bonding apparatus according to Claim 7 or 8, characterized in that in a case where an optical system of said optical measuring instrument is an object-side telecentric optical system, said light path that passes through a light path length varying element is provided at an intermediate point on a light path that extends from said object of bonding toward said image focusing lens.

12. The bonding apparatus according to Claim 8, characterized in that said four-reflection-surface reflective mirror is comprised of:

a right-angled outside reflective mirror in which a first reflective surface and a second reflective surface are disposed at an angle of 270 degrees, and

a right-angled inside reflective mirror in which a third reflective surface and a fourth reflective surface are disposed at an angle of 90 degrees; and

said first reflective surface and third reflective surface are provided to face each other, said second reflective surface and fourth reflective surface are provided to face each other, and said reflective surfaces facing each other are parallel to each other at a specified interval.

13. The bonding apparatus according to Claim 2 or 9, characterized in that said mirror-reflection-operation optical element is a reflective mirror.

14. The bonding apparatus according to Claim 2 or 9, characterized in that said mirror-reflection-operation optical element is an optical element that is a combination of a pentagonal prism and a triangular prism.

15. The bonding apparatus Claim 3 or 10, characterized in that said rotational-operation optical element is comprised of a first prism that reflects incident light rays twice and a second prism that twice reflects light rays from said first prism.

16. A bonding external appearance inspection apparatus which performs a bonding external appearance inspection with a focal point position varied for an object of bonding that has a plurality of different heights, said inspection being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a parallel flat plate, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding external appearance inspection apparatus is characterized in that said light path that passes through a parallel flat plate is a light path which:

receives light rays from the object of bonding,

conducts said light rays from the object of bonding to said two-dimensional image sensor after causing said light rays from the object of bonding to pass twice through a parallel flat plate that has a refractive index and thickness that corresponds to a height of the object of bonding, and

varies a focal point position of an optical system while eliminating an image deviation generated by the passing of said light rays through a parallel flat plate.

17. A bonding external appearance inspection apparatus which performs a bonding external appearance inspection with a focal point position varied for an object of bonding that has a plurality of different heights, said inspection being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a light path length varying element, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding external appearance inspection apparatus is characterized in that:

said light path that passes through a light path length varying element includes a parallel reflective mirror as a light path length varying element, said parallel reflective mirror being comprised of two reflective surfaces facing each other and disposed parallel to each other at a specified interval and varying a light path length of light rays that pass through said parallel reflective mirror when said parallel reflective mirror is rotated as a whole about a rotational axis that is perpendicular to an optical axis; and

said light path that passes through a light path length varying element is a light path which:

receives light rays from the object of bonding,

conducts the light rays from the object of bonding to said two-dimensional image sensor after causing said light rays from the object of bonding to pass twice through said parallel reflective mirror that varies the light path length according to a height of the object of bonding, and

varies a focal point position of an optical system while eliminating, by mutual cancellation, an image deviation generated by a passing of said light rays through said parallel reflective mirror.

18. A bonding external appearance inspection apparatus which performs a bonding external appearance inspection with a focal point position varied for an object of bonding that has a plurality of different heights, said inspection being performed using an optical measuring instrument that includes:

an image focusing lens,

a two-dimensional image sensor that detects an image of each object of bonding created by said image focusing lens, and

a light path that passes through a light path length varying element, said light path being disposed at an intermediate point in a light path that extends from said object of bonding toward said two-dimensional image sensor;

wherein said bonding external appearance inspection apparatus is characterized in that:

said light path that passes through a light path length varying element includes a four-reflection-surface reflective mirror as a light path length varying element, said four-reflection-surface reflective mirror being comprised of four reflective surfaces facing each other and disposed parallel to each other at a specified interval and varying a light path length that corresponds to a light path length inside said four-reflection-surface reflective mirror, relative to a case in which said four-reflection-surface reflective mirror is not inserted, when said four-reflection-surface reflective mirror is inserted as a whole in a light path; and

said light path that passes through a light path length varying element is a light path which:

receives light rays from the object of bonding,

conducts the light rays from the object of bonding to said two-dimensional image sensor after causing said light rays from the object of bonding to pass twice through said four-reflection-surface reflective mirror that has a light path length corresponding to a height of the object of bonding, and

varies a focal point position of an optical system while eliminating, by mutual cancellation, an image deviation generated by a passing of said light rays through said four-reflection-surface reflective mirror.